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FERNS AND FERN-ALLIES OF DALHOUSIE HILLS

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ABSTRACT

The paper deals with the ecological distribution and enumeration of species of ferns and fern-allies from the Dalhousie hills covering an area of 170 sq. km and altitudinal range between 600-3,000 m. A total of 88 species of ferns and 6 of fern-allies have been reported. *Athyrium proliferum*, *A. gymnogrammoides*, *A. mackinnoni* and *Polypodium sub-amoenum* are first records from the area.

INTRODUCTION

There is no comprehensive record of the Pteridophytic Flora of Dalhousie hills. Fragmentary reports are available in the works of Clarke (1880), Beddome (1863, 1883, 1892) and Hope (1899-1904), and these completely lack information concerning ecology, distribution and altitudinal range of the species.

The collections on which the present paper is based were made in the summers of 1962 and 1963 with a view to compile an upto date list of ferns and fern-allies of the area giving latest nomenclature along with the distributional pattern of the species. This is a part of the project of writing detailed monographic account of the ferns and fern-allies of the Western Himalayas.

GEOGRAPHICAL LIMITS

Dalhousie, a beautiful health resort, is situated at 32°31′N latitude and 75°59′E longitude, at an average altitude of 2,000 m, on the outer slopes of Dhaula Dhar range of North Western Himalayas.

In addition to the survey of valleys around Dalhousie and other picnic places like Panjpulla, Karelnu waterfalls, Balun (1,500 m), Jandrighat, Banikhet (1,500 m), Motitiba, Bakrota (2,400 m), excursions were also undertaken to Kalatop (2,400 m), Khajjiar (2,400 m) and Dainkund (3,000 m). A few excursions were also made to Chamba via Khajjiar, Sherpur (600 m) and Dunera (600 m) en route Pathankot.

The high altitude vegetation is not very much represented in the area surveyed, but low altitude ferns have been studied around Sherpur in Ravi valley and near Dunera (600 m).

The area explored is approximately 170 sq. km and falls within an altitudinal range of 600-3,000 m (Map).

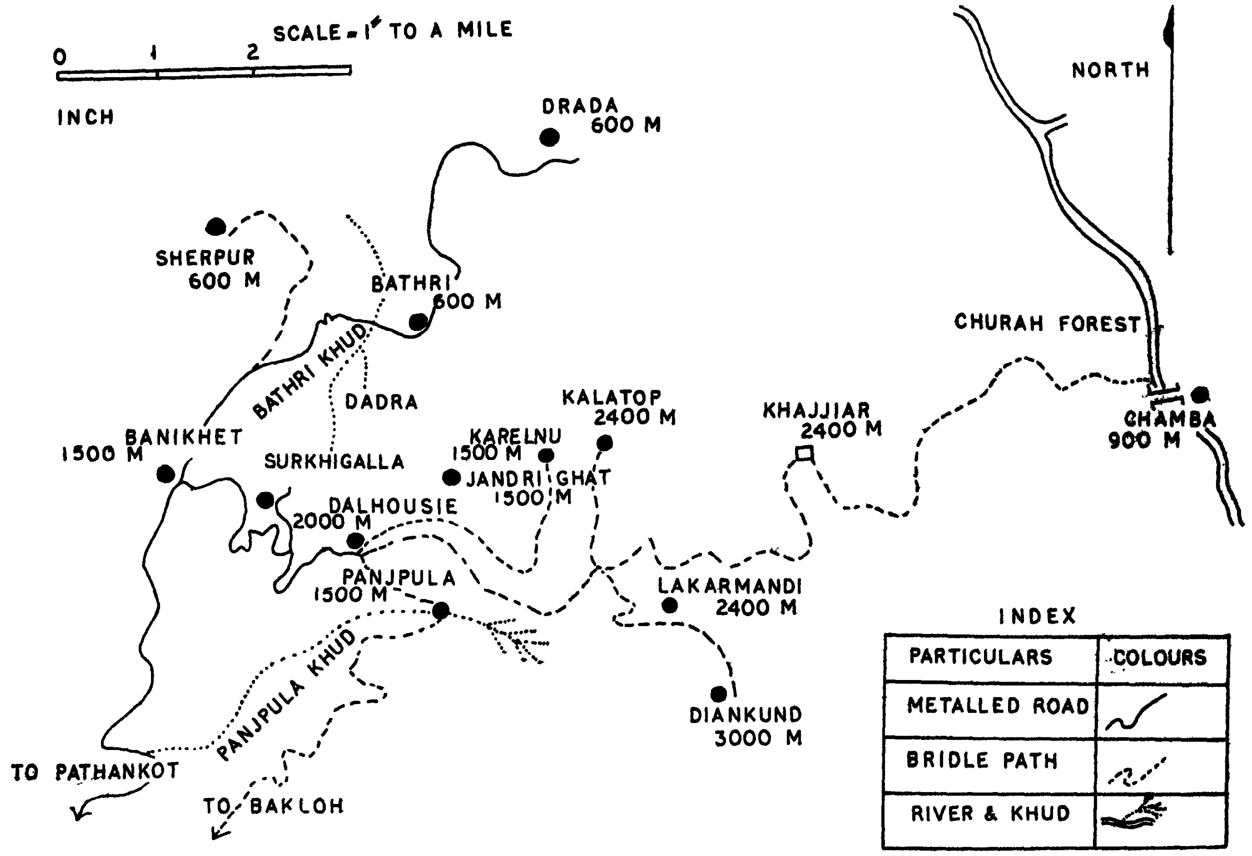
CLIMATE AND SOIL

The climate of Dalhousie hills is moist at higher elevations but rather warm and dry at lower altitudes. The average annual rainfall is about 2,500 mm, of which about 65% is during the rainy season which commences from the middle of June and lasts till the end of September. The mean relative humidity at 0830 hrs. (I.S.T.) ranges from the lowest of 53% in November to 91% in August when it is at its peak. January is the coldest month which registers the average minimum temperature of 2.1°C and average maximum of 10.9°C. On the other hand, June is the warmest month with an average minimum of 18.1°C and average maximum of 27.9°C. Snowfall usually starts in the middle of December and continues intermittently, generally till the end of February. March, April and May are the three windy months when the mean wind speed varies from 5.9 to 6.8 km per hour. The full meteorological data are given in Table I.

TABLE I : *Normal meteorological data for Dalhousie (based on observations from 1930-1960).*

Month	Mean max. temp. (°C)	Mean min. temp. (°C)	Monthly total rainfall (mm)	Mean rel. humidity at 0830 hrs, I.S.T. (%)	Mean wind speed (km/hr)
January	10.9	2.1	204.8	67	3.6
February	13.5	4.1	155.9	62	3.9
March	17.7	8.0	148.5	60	5.9
April	22.8	11.9	77.2	55	6.3
May	25.9	15.7	67.9	59	6.8
June	27.9	18.1	117.2	63	4.8
July	23.7	16.8	619.6	86	2.8
August	22.7	16.5	615.0	91	2.1
September	23.0	15.4	298.8	84	2.5
October	21.6	11.7	83.3	64	3.1
November	18.5	7.8	21.4	53	2.6
December	15.1	5.1	83.8	55	2.9

The rocks constituting the sub-soil are gneiss and granite. At lower altitudes, the underlying rock is conglomerate containing pebbles and the soil is very friable. The surface soil is usually clayey and fertile in Kalatop and Churah forests but in Banikhet and part of Surkhigalla forest it is far less fertile.



Map of Dalhousie Hills and surrounding areas investigated

GENERAL ASPECT OF VEGETATION

The general aspect of vegetation is determined primarily by elevation but other physical factors like the direction of slope of the ridges, the degree of slope, nature of the soil whether dry, hard and friable, or deep loamy humus, or formed of decaying pine needles and hence acidic in nature, local microclimatic conditions like the proximity of nallahs or ravines, also play quite an important part.

In general between 900-1,500 m the climate is subtropical arid type in which *Pinus roxburghii* is the dominant tree, occurring either in almost pure formations or at higher levels mixed to a greater or lesser extent with *Quercus incana, Rhododendron arboreum, Pieris ovalifolia, Pyrus pashia,* with a sprinkling of *Albizzia odoratissima.* In these forests the undergrowth consists chiefly of species of *Berberis, Indigofera tinctoria, Plectranthus rugosus* and *Cotoneaster microphylla.*

Above 1,500 m the forest assumes a temperate aspect. *Quercus incana* becomes more abundant. *Pinus roxburghii* disappears and is replaced by *Cedrus deodara* which becomes increasingly dominant with increase in altitude so that the oak forms an understorey between 1,800-2,400 m. Their common associates at these elevations are *Aesculus indica, Rhododendron arboreum, Pyrus pashia, Cornus capitata, Prunus padum,* species of *Acer* and laurels. The shrubby element under the forest is constituted by species of *Berberis, Desmodium floribundum, Viburnum cotinifolium, Rhus semialata, Sarcococca pruniformis, Spiraea canescens, Deutzia staminea, Ilex dipyrena, Rosa moschata. Vitis himalayana, V. divaricata,* and *V capreolata* are the climbers on oak and sometimes also on other trees.

Between 2,400-2,700 m in the forests at Kalatop the Deodar becomes gradually replaced by *Abies* *pindrow* and *Picea morinda*, and the low level oak, *Quercus incana*, gives place to *Q. semicarpifolia*.

ECOLOGICAL OBSERVATIONS ON THE PTERIDOPHYTIC FLORA

The distribution of ferns is mainly between 1,500-2,700 m altitude. Lower down and higher up the fern flora decreases rapidly both in variety and the number of individuals. Under the pine forests on the acidic soil with high pH value, there is marked paucity of growth of herbaceous angiosperms as well as ferns.

Ecologically the ferns may be grouped into the following categories, according to their growth habit and the habitats they occupy. The most dominant species have been mentioned under each category.

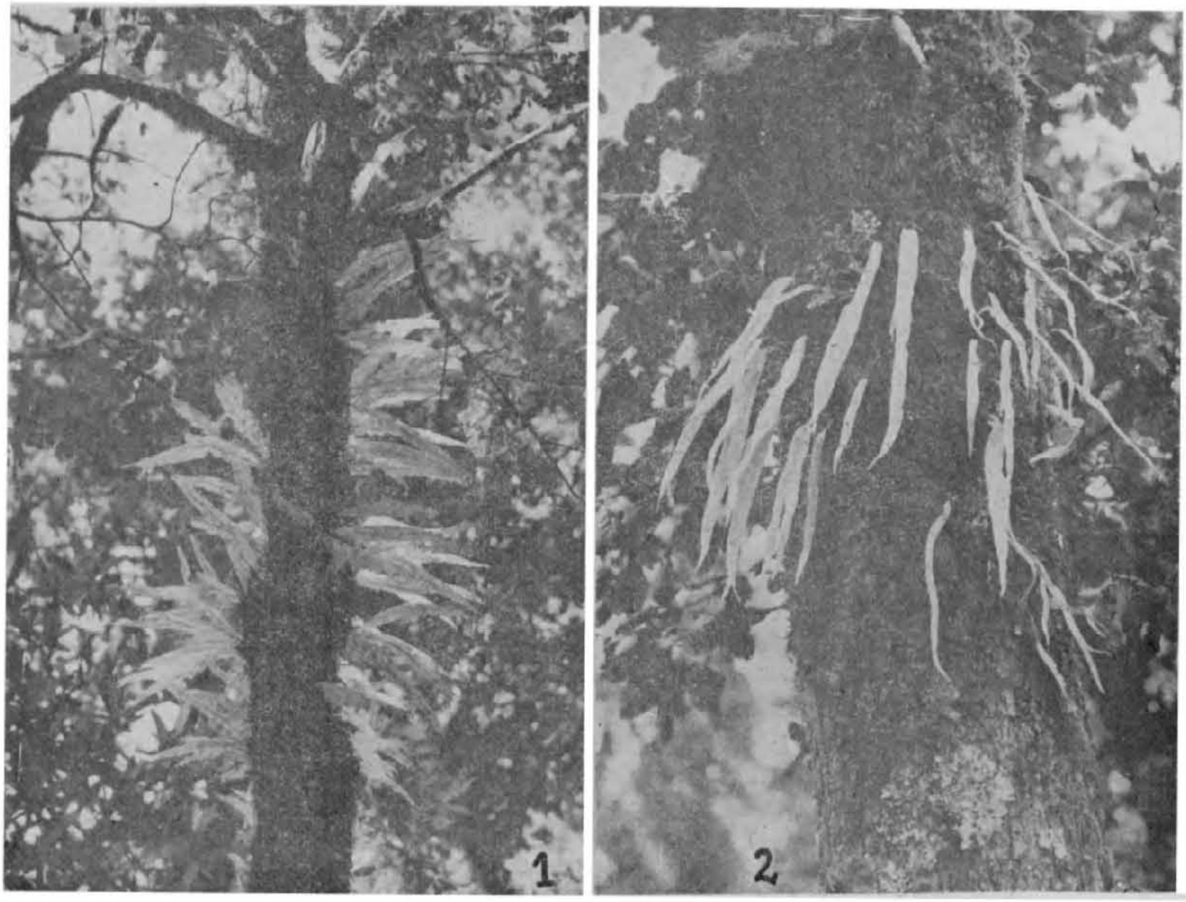


Plate I

Figs. 1-2 : 1. *Lepisorus excavatus* growing epiphytically. Note the thick felt of liverworts and mosses providing substratum for rhizome to penetrate. 2. Another epiphyte *Lepisorus clathratus*.

Epiphytes: In these hills the epiphytic vegetation is luxuriant only within the range of 1,800-2,400 m. The epiphytes complete their life-span during the short rainy season after which the fronds wither and the rhizomes become dormant to renew their activity during the next rains. The chief host is *Quercus incana*, the branches and trunks of which are thickly covered with mosses and leafy liverworts which serve the purpose of storage of water and into which the rhizomes penetrate for water supply and protection.

Foot epiphytes grow near the base of tree-trunks where they receive intermittent washings from the tree-tops. These include *Didymoglossum insigne* v.d.B. and *Mecodium exsertum* Copel. Besides these *Microsorium membranaceum* (Don) Ching and rarely *Asplenium dalhousiae* (Hook.) C. Chr. and *Onychium contiguum* (Wall.) Hope are also met in these situations.

Luxuriant growth of the epiphytic ferns is on the branches of trees among the shade of leaves, where they are well protected from wind and

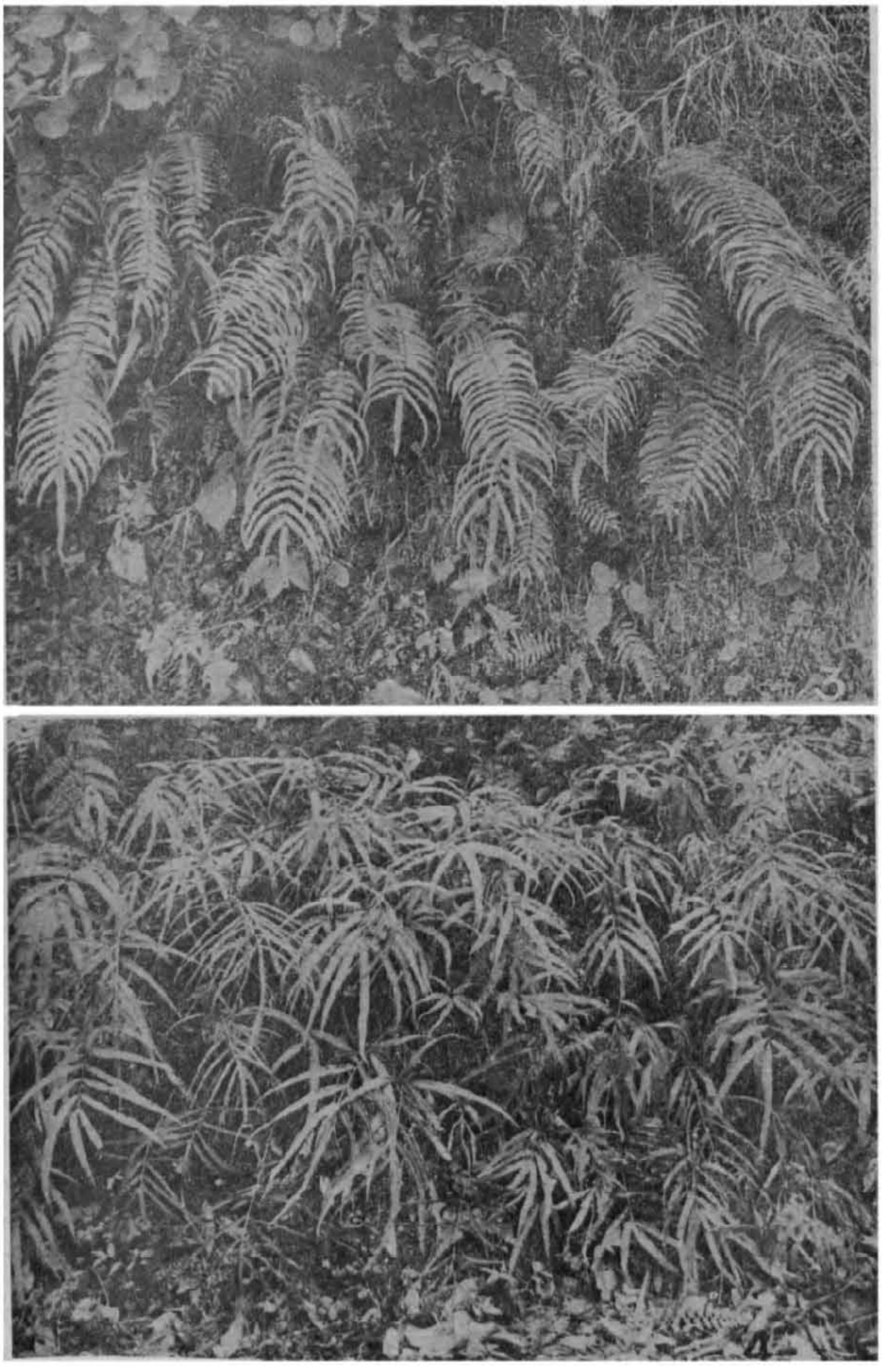


Plate II
Figs. 3-4 : 3. *Pteris vittata*—a low altitude species along the roadside. 4. *Pteris cretica* with dimorphic fronds.

exposure. The common epiphytes in such situations are *Araiostegia pseudocystopteris* (Kze.) Copel., *Polypodium microrhizoma* Clarke, *P. amoenum* Wall. and *Lepisorus excavatus* (Bory) Ching (Fig. 1). These are usually associated with a few epiphytic angiosperms like *Sedum trifidum*,

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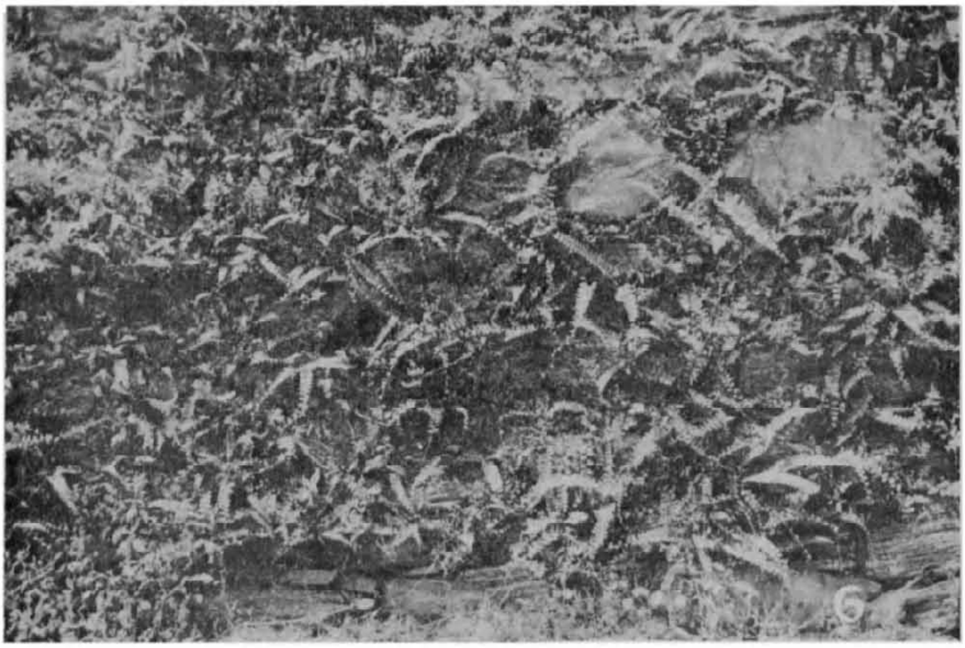
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Plate III

Figs. 5-6 : 5. A bed of *Athyrium schimperi*. 6. *Adiantum incisum* growing on stony wall.

Thalictrum sp. and *Gonatanthus sarmentosus*. *Phymatodes erythrocarpa* (Mett.) Ching and *Lepisorus clathratus* (Clarke) Ching (Fig. 2) are the common and conspicuous epiphytic ferns at higher altitudes.

Polypodium lachnopus Wall. and *Lepisorus nudus* (Hook.) Ching are found generally below 1,800 m on short and stunted trees at the top of the ridges where they are subjected to strong winds. The latter species is more abundant than the former and persists even under adverse dry conditions when the margins of their fronds become inrolled to conserve moisture.

Ferns inhabiting forest floor and forest borders: A majority of ferns grow on the forest floor and on forest borders. These species mostly belong to the genera *Pteris* Linn., *Dryopteris* Adanson, *Athyrium* Roth, *Diplazium* Swartz, *Thelypteris* Schmidel and *Cyclosorus* Link.

At low altitudes are commonly found *Cyclosorus dentatus* (Forsk.) Ching and *Pteris vittata* Linn. in such situations (Fig. 3).

Between 1,800-2,400 m altitude, the conditions at the forest floor are mesophytic. The forests are fairly dense so that rays of sun do not directly reach the forest floor. The climatic fluctuations during the day are not very significant in Kalatop and Khajjiar forests. *Polystichum squarrosum* Don, *P. aculeatum* Sw., *Pteris cretica* Linn. (Fig. 4), *Coniogramme intermedia* Hieron., *C. caudata* (Wall.) Ching, *Diplazium polypodioides* (Mett.) Bl. are exceedingly common forming large patches. *Athyrium mackinnoni* (Hope) C. Chr., *A. schimperi* Moug. (Fig. 5), *A. clarkei* Bedd., *Dryopteris chrysocoma* (Christ) C. Chr., *D. marginata* (Wall.) Christ, *D. cochleata* (Don) C. Chr. are the other common species met along borders of these forests.

In open situations near Dainkund (2,600 m), *Onychium contiguum* Hope shows luxuriant growth forming large patches in the grasslands.

Species growing on the exposed rocks along roadside under xerophytic conditions: The water holding capacity of rocky soils along the roadside is poor. Diurnal temperature fluctuations and humidity changes are great. There is no protection against the direct sun. These factors result in xerophytic aspect of the vegetation. The dry boulders and rock walls are largely inhabited at lower altitudes by *Cheilanthes farinosa* (Forsk.) Kaulf., *C. anceps* Blanford. *Adiantum incisum* Forsk. (Fig. 6) and *Hypodematium crenatum* (Forsk.) Kuhn. In the last species the rhizome is thickly covered over by golden brown scales and it penetrates deep into the crevices of rocks.

At a little higher altitude, at about 1,800 m, *Cheilanthes albomarginata* Clarke, *C. dalhousiae* Hook. and *Gymnopteris vestita* (Wall.) Underw. are common round about Dalhousie. The last species can stand very arid conditions and its fronds are densely covered with brown silky scales to reduce excessive transpiration.

Ravine ferns: The vegetation in the ravines is different from that on the forest floor owing to relatively lower temperature and higher humidity. Also the diurnal fluctuations in temperature and humidity in the ravines are not so marked. There are two distinct habitats which harbour different species.

(*a*) *Hygrophytic lithophytes:* These are the plants which grow on rocks by the side of ravines. The common examples between 1,500-2,000 m are *Polypodium amoenum* Wall., *P. microrhizoma* Clarke (Fig. 7), *Araiostegia pseudocystopteris* (Kze.) Copel., *Adiantum venustum* Don (Fig. 8) and *A. capillus-veneris* Linn. Sometimes on the shaded walls of the ravines, fronds of *Woodwardia radicans* (L.) J. Smith and *Thelypteris erubescens* (Wall. ex Hook.) Ching are seen drooping from the moist rocks.

(*b*) *Hygrophytes on rocky soil:* Under this category come ferns which grow in ravines along water channels. *Diplazium polypodioides* (Mett.) Bl., *Thelypteris erubescens* (Wall.) Ching, *T. brunea* (Wall.) Ching, *Woodwardia radicans* (L.) J. Smith, *Coniogramme indica* Fee, are the commonest ferns which grow on calcareous gravelly soil in these environments. *Equisetum diffusum* D. Don is often abundantly met with.

Thicket-forming species: Only one species is met with in the area with this habit, e.g., *Pteridium aquilinum* (L.) Kuhn. It generally grows on open ridges on rocky and gravelly soil along the roadside so that it is exposed to wind and wide variation of temperature. It is a good soil binder but does not permit any other species to grow alongside.

Hydrophytic ferns: The common hydrophytes are *Marsilea minuta* L. and *Salvinia auriculata* Aublet. These species are found only in the Khajjiar lake.

ENUMERATION

The arrangement of the families of ferns in presenting the list of species is according to the phylogenetic scheme proposed by Mehra (1961a). The species marked with asterisk were not collected by the authors but these have been reported by other workers from the area. Short notes are added wherever needed.

Plate IV
Figs. 7-8 : 7. *Polypodium microrhizoma* growing as a lithophyte in a ravine. 8. *Adiantum venustum* growing in similar environments.

FERNS

OPHIOGLOSSACEOUS SERIES

OPHIOGLOSSACEAE

Botrychium lanuginosum Wall., List no. 48, 1828.

Nainikhud on way to Dunera at 1,500 m in exposed situations on rocky walls where sufficient humus has accumulated.

***Ophioglossum vulgatum** Linn., Spec. Plant. 2: 1062, 1753.

According to Hope (1899-1902), it is met with at Kantli near Dalhousie (1,950 m).

SCHIZAEACEOUS SERIES

SCHIZAEACEAE

***Lygodium japonicum** (Thbg.) Sw. in Schrad. Jour. 1800^2, 106, 1801.

Clarke (1880) reports it to be present throughout north India extending west to Kashmir and ascending to 1,500 m altitude.

MARSILEACEAE

Marsilea minuta Linn. Mant. 308, 1771 (excl. β).

Very common in shallow water along the margin of Khajjiar lake (1800 m).

ADIANTACEAE

Adiantum edgeworthii Hook., Sp. Fil. 2, 14 t. 81B, 1851.

A very common species at 900-1,200 m, on slaty rocks where a little humus has collected. Occasionally found growing in *Pinus roxburghii* forests near the bases of trees among needles.

A. incisum Forsk., Fl. Aeg. Ar. 187, 1775.

One of the most common species between 600-1,200 m, growing in rather exposed situations in rock crevices along roadside near Bathri (900 m), Chamba (1,000 m), Panjpulla khud (1,200 m) and at Dunera (600 m) (Fig. 6).

A. lunulatum Burm., Fl. Ind. 235, 1768.

A common low level fern, met in moist situations in the plains and ascending upto 900 m. The apex of frond is often rooting and hence it is called "walking fern".

A. capillus-veneris Linn., Spec. Plant. 2 : 1096, 1753.

Quite common in hygrophytic environments by the side of springs at Satdhara (1,800 m), Banikhet (1,500 m) when usually sterile, but when growing in rather exposed conditions near Lakarmandi (2,400 m), the fronds are larger, stiffer and commonly fertile.

A. venustum Don, Prod. Fl. Nepal 17, 1825.

This is the commonest high altitude *Adiantum* met between 1,800-3,000 m. Grows in patches sometimes covering large areas (Fig 8).

A. davidi Franchet (?), nouv. Arch. Mus. II. 10: 112, 1887.

Commonly found in Dalhousie at about 1,800-2,400 m along with *A. venustum.*

CRYPTOGRAMMACEAE

Onychium contiguum Hope in Jour. Bombay nat. Hist. Soc. 13: 444, 1901.

Very common in these hills growing in variable habitats. Four morpho-variants have been differentiated: (a) Fronds sub-coriaceous and pale-green in colour; met on moist, shady and humus rich places, (b) Fronds very large, finely dissected, herbaceous and light green; grows in deep forests in thickly shaded places near water courses. (c) Fronds coriaceous, pale-green in colour; met in rather exposed, dry conditions. (d) As above but the base of the stipe possesses prominent scales; grows on the forest floor in dry conditions.

All these morpho-variants conform to the species *O. contiguum* in having the characteristic large pale-coloured stipe with black basal part and straw-coloured sori closely covered over by the indusium.

O. lucidum (Don) Spr., Syst. 4: 66, 1827.

This is a very common species at Kalatop (2,400 m), Karelnu waterfalls (1,800 m), Bathri (1,200 m) and Sherpur (950 m). Grows in variable habitats.

***O. japonicum** (Thbg.) Kze. Bot. Zeit. 507, 1848.

Hope (1901) has reported its presence in Dalhousie hills on Chamba-Khajjiar road at 1,500 m.

SINOPTERIDACEAE

Cheilanthes albomarginata Clarke in Trans. Linn. Soc. Lond., II. Bot. 1: 456, t. 52, 1880.

Very common on the exposed rocky walls near Banikhet (1,350 m), Dalhousie (2,100 m).

C. dalhousiae Hook., Spec. Fil. 2: 80, t. 78B, 1852.

Quite common at Dalhousie (2,000 m), Motitiba (2,400 m) and Panjpulla (2,100 m), grows in somewhat humid conditions.

C. dubia Hope in Jour. Bombay nat. Hist. Soc. 12: 528, t. 2, 1899.

Rare, grows in rather exposed situations along the roadside near Katholag (1,800 m).

C. farinosa (Forsk.) Kaulf., Enum. 212, 1824.

Common in rock crevices in rather exposed places on Panjpulla road (1,200 m) and Dunera road (600 m).

Cheilanthes anceps Blanford in Simla Nat. Hist. Soc. Leaflet, 25th June, 1886.

Very common in the shaded ridges along Bathri-Sherpur road at 900 m.

C. rufa Don, Prod. Fl. Nepal 16, 1825.

Not common, met with in Jandrighat (1,500 m) and Churah forest (1,800 m), the rhizome penetrates rock crevices in exposed slopes.

***C. sub-villosa** Hk. Sp. 2 : 87, t. 98B, 1852.

According to Hope (1900), it is met with in Kalatop forest at 2,250 m.

***C. persica** (Bory) Mett.; Kuhn, Fil. Afr. 73, 1868.

Hope (1900) reports it near Chamba at 1,500 m.

Pellaea nitidula (Wall.) Baker, syn. Fil. 149, 1867.

Quite common in the exposed situations on the road from Jandrighat to Karelnu waterfalls (1,500 m), also near Lakarmandi (1,800 m).

GYMNOGRAMMACEAE

Anogramma leptophylla (L.) Link, Fil. Sp. 137, 1841.

A very common species between 1,800-2,700 m, along Panjpulla road (1,800 m), Mall road (2,000 m), Jandrighat (1,800 m) and near Lakarmandi (2,400 m). This is a small fern of moist and shaded places growing alongwith mosses especially *Rhodobryum* sp.

Coniogramme fraxinea (Don) Diels var. **denticulato-serrata** Hieron

Common at Karelnu waterfalls (1,200 m), Panjpulla (1,500 m) and Tindhara (1,800 m). Hope has reported the type species from Kalatop forest at 2,400 m.

C. intermedia Hieronin Hedwigia 67 : 301, 1916.

Very common at higher altitudes on the forest floor at Dainkund (3,000 m), Khajjiar and Kalatop forests (2,400 m).

var. **glabra** Ching, Ic. Fil. Sinicarum 3, Pl. 143, 1935.

Common in the Kalatop forest near Lakarmandi, at 2,700 m.

C. caudata (Wall.) Ching in Christensen, Index Fil., Suppl. III: 56, 1934.

A very common species in moist habitat, where the soil is clayey and humus rich. It is met with in lower Chamba range in Churah forest (1,800 m) on Khajjiar-Chamba road.

C. affinis (Wall.) Hieronin Hedwigia 57 : 297, 1916.

Not common, met with in Panjpulla waterfalls (1,800 m), growing on rocks with a little sandy soil.

Gymnopteris vestita (Wall.) Underw. Bull. Torrey Bot. Club, 29 : 627, 1902.

Quite common on the exposed walls on Bakloh road (1,800 m), Karelnu waterfalls (1,500 m) and Bakrota (2,400 m).

PTERIDACEAE

Pteris vittata Linn., Spec. Plant. 1074, 1753.

This is a very common low level species near Chamba (600 m), Kayani spring (900 m) and Khajjiar-Chamba road (1,200 m) (Fig. 3).

P. cretica Linn., Mant., 130, 1767.

Extremely common in between 1,500-2,400 m growing in large patches and sometimes covering the entire hill side. Fertile fronds usually narrower than sterile ones (Fig 4) but occasionally fronds with equally broad fertile pinnae are observed.

P. excelsa Gaud., Freye. Voy. Bot. 338, 1829.

Quite common near water courses like Panjpulla 1,800 m and Karelnu waterfalls (1,500 m) growing in hygrophytic conditions.

P. wallichiana Ag., Rec. Spec. Gen. Pterid. 69, 1839, type from Himalayas.

Only one colony was seen in rather exposed situations on calcareous gravelly soil along the streamlet that runs from Balum to Bathri at 1,200 m.

P. quadriaurita Retz. in Obs. Bot. 6 : 38, 1791 (*sensu lato*).

One of the commonest lithophytes at 2,000 m in moist and shaded places.

HYMENOPHYLLACEAE

Didymoglossum insigne v.d.B., Ned., Kr. Arch. 5^3: 143, 1863.

Not common, met on the lower portion of the tree-trunks at Panjpulla waterfalls (1,800 m).

Mecodium exsertum (Wall. ex Hook.) Copel. in Phil. Sci. 67: 23, 1938.

Not common, met at Panjpulla waterfalls (1,800 m). Only a few specimens could be collected.

SALVINIACEAE

Salvinia auriculata Aublet, Hist. Pl. Guian. 2: 969, t. 367, 1775.

Found plentifully in Khajjiar lake at 1,800 m but nowhere else in the area surveyed.

HYPOLEPIDACEAE

Hypolepis punctata (Thbg.) Mett., Kuhn, Fil., Afr. 120, 1869.

Commonly found in exposed places near Drada (1,200 m) and Chamba (1,500 m).

Pteridium aquilinum (L.) Kuhn ex Decken, Reisen in Ost. Afrika 3: 11, 1879.

One of the hardiest xerophytic species. Very common from Banikhet (1,500 m) to Dalhousie (1,800 m) and near Khajjiar (1,800 m) but does not extend higher up.

According to Clarke (1880), it belongs to the var. *lanuginosa,* with ultimate segments oblong and yellow-hairy beneath.

DAVALLIACEAE

Araiostegia pseudocystopteris (Kze.) Copel. in Phil. Jour. Sci. 34: 241, 1927.

One of the commonest epiphytes all around Dalhousie from 1,500-2,400 m. Occasionally met as lithophyte.

***Leucostegia immersa** (Wall.) Presl, Tent. Pterid. 95, t. 4, f. 11, 1836.

Hope reports its presence in Dalhousie hills.

ASPIDIACEAE

Cyrtomium caryotideum Presl, Tent, Pterid. 86, t. 2, f. 26, 1836.

Met at Karelnu waterfalls (1,800 m) growing on rocky gravelly soil.

Dryopteris odontoloma (Moore) C. Chr. in Acta Hort. Gothob. 1: 59, 1924.

A common species between 1,800-2,400 m near Lakarmandi (2,400 m) and on Bakloh road (1,800 m) growing on the shaded forest floor.

D. marginata (Wall.) Christ in Phil. Jour. Sci. Bot. 2: 212, 1907.

A common species on humus rich densely shaded forest floor near Phrukta (1,500 m) on way to Bathri.

D. chrysocoma (Christ) C. Chr., Index Fil. 257, 1905.

Met in plenty near Lakarmandi (2,400 m) growing in exposed situations by the roadside.

D. cochleata (Don) C. Chr., Ind. 258, 1905.

Restricted to dry forests at the foot hills rising up to 1,200 m near Phrukta on way to Bathri. A characteristic feature of the species is dimorphic fronds, the fertile frond completely covered over by large, prominent sori.

Hypodematium crenatum (Forsk.) Kuhn, v. Deck. Reis. 3^3. Bot. 37, 1879.

Commonly grows in exposed situations near Bathri at 900 m. Very variable in size, pinnation and density of pubescence.

Polystichum squarrosum (Don) Fee, Gen. Fil. 278, 1850-52.

One of the commonest species between 1,800-2,400 m on Panjpulla road (1,800 m), Dalhousie-Banikhet road (1,800 m) and at Bakrota (2,400 m). A hardy species which survives the winter snow and persists throughout the year.

P. aculeatum (L.) Schott, Gen. Fil. ad. t. 9, 1834.

Common on exposed slopes at Upper Bakrota (2,400 m) and near Lakarmandi (2,400 m).

During the present explorations a number of specimens have been collected which seem to be probable hybrids between *P. squarrosum* and *P. aculeatum.*

***P. acanthophyllum** (Franchet) Christ in Bull. Soc. Bot. Franc. 52, Mem. 1 : 30, 1905.

According to Hope it is met in Dalhousie hills at 2,250 m.

ATHYRIACEAE

Athyrium clarkei Bedd., Ferns br. Ind. Suppl. ii t. 360, 1876.

A fern of densely shaded forest floor near Khajjiar (2,250 m) where it forms large patches.

A. proliferum Moore, Gard. Chr. 778, 1866.

Quite common on humus rich, densely shaded forest floor in Kalatop forest and near Lakarmandi (2,400 m). A new record for the North-Western Himalayas.

A. rupicola (Hope) C. Chr., Index Fil. 145, 1905.

A common high altitude fern, met on the forest floor along Lakarmandi-Khajjiar road (2,700 m) and in Churah forest (2,500 m).

A. gymnogramoides (Kl.) Bedd. Ferns South India t. 156, 1863.

Not common, grows in humus rich, moist and shaded places in Churah forest (2,100 m). New record for the area.

A. schimperi Moug. ex Fee, Mem. Fougeres 5 (Gen. Fil.), 187, 1850-52.

One of the commonest species between 1,200-2,400 m along forest borders (Fig. 5).

A. setiferum C. Chr., Index Fil. 146, 1905 and Suppl. III : 44, 1934.

A common species generally near water courses at Panjpulla (1,800 m), Surkhigalla (1,500 m). Prominent setae are present along the veins on the dorsal surface of the frond.

A. mackinnoni (Hope) C. Chr., Ind. 143, 1905.

This is a common species between 1,800-2,400 m in Churah forest on Khajjiar road, grows under moist shaded conditions on forest floor. A new record for the area.

A. japonicum (Thbg.) Copel. in Phil. Jour. Sci. Bot. 3C: 290, 1908.

Rare, met in Churah forest on Lakarmandi-Khajjiar road, grows on moist and shaded forest floor.

Athyrium pectinatum (Wall.) Presl, Tent. Pterid. 98, 1836.

Not a common species. Found growing in rather exposed places at 1,800 m. A little variable from the typical *pectinatum* in size and cutting of the pinnules.

A. thelypteroides (Michx.) Desv., Prod. 226, 1827.

Very common, grows luxuriantly along the stream in Churah forest at 2,400 m.

***A. dentigerum** (Clarke) Mehra et Bir, Amer. Fern Journ. 50: 279, 1960.

According to Hope, met with in Dalhousie at 1,800 m. Not seen by the authors.

Diplazium polypodioides Blume, Enum. Pl. Jav. 194, 1828.

Extremely common on shaded forest floor along roadside at 2,400 m. The delicate young circinately coiled fronds called "Lingra" are used as vegetable by the natives.

***D. esculentum** (Retz.) Sw., Schrad. Jour. Bot. 1801^2, 213, 1803.

Hope reports it to be present at Chamba at 900 m. Not observed by the authors.

D. asperum Blume, Enum. 195, 1828. (HB 238).

Common on humus rich, shaded forest floor at 2,400 m on Khajjiar road.

THELYPTERIDACEAE

***Ampelopteris prolifera** (Retz.) Copel., Gen. Fil. 144, 1947.

Hope reports its presence near Dalhousie at 900 m. Not collected by the authors.

Cyclosorus dentatus (Forsk.) Ching in Bull. Fan. Mem. Inst. Biol. 8: 206, 1938.

Quite common at lower altitudes in moist and shady places along water courses in Bathri khud (900 m) and Panjpulla khud (1,200 m).

C. papilio (Hope) Ching in Bull. Fan. Mem. Inst. Biol. 8: 214, 1938.

Not uncommon. Met between 1,050-1,500 m on way to Bathri from Balun growing in moist shady conditions on calcareous gravelly soil.

Thelypteris repens (Hope) Ching in Bull. Fan. Mem. Inst. Biol. 6: 304, 1936.

Commonly met with in Surkhigalla ravine at 1,600 m in rather moist shady environments on calcareous soil.

T. brunea (Wall.) Ching in Bull. Fan. Mem. Inst. Biol. 6: 269, 1936.

Common all around at 1,500-2,100 m altitude, generally grows in damp situations near Bathri (1,500 m) and Karelnu waterfalls (2,100 m).

T. erubescens (Wall. ex Hook.) Ching in Bull. Fan. Mem. Inst. Biol. 6: 293, 1936.

Extremely common in ravines like Surkhigalla khud (1,600 m), Panjpulla khud (1,600 m) and Naini khud (1,500 m).

***T. palustris** Schott, Gen. ad t. 10, 1834.

According to Hope, found along the margin of Khajjiar lake, 1,800 m and Khajjiar bog, 1,950 m.

This species was considered by Carl Christensen (1906) under the genus *Dryopteris* and called *D. thelypteris* (L.) A. Gray. Pichi-Sermolli in the latest Index Filicum Suppl. (1934-60) has transferred it to the genus *Polystichum* and designated it as *P. thelypteris* (L.) Roth. However, Tryon (1954) retained the original name *Thelypteris palustris* Schott. This species has recently been investigated in our laboratory and chromosome number is found to be $n=35$. Both the genera *Dryopteris* and *Polystichum* are invariably based on $x=41$, whereas in the genus *Thelypteris* variable base numbers, including $x=35$ are reported. On this basis it has been considered appropriate to retain the species under the genus *Thelypteris.*

ASPLENIACEAE

Asplenium dalhousiae Hook., Ic. Pl. t. 105, 1837.

Extremely common all around Dalhousie on Bakrota road (2,400 m), Panjpulla (1,800 m), Lakarmandi (2,700 m), Kalatop (2,400 m), Bathri (1,200 m) and Jandrighat (1,800 m). It occurs in a variety of habitats, on the banks of streamlets, in moist and shady places and occasionally as an epiphyte also.

A. varians Wall. in Hook. & Grev. Ic. Fil. t. 172, 1830.

Quite common between 2,400-3,000 m, grows in dense forests at the base of the tree trunks and sometimes as lithophyte all along Lakarmandi-Khajjiar road, Kalatop forest and Dainkund.

A. trichomanes Linn. Sp. Pl. 1080, 1753.

Extremely common near Bakrota (2,400 m), Bara Pathar (2,400 m), Lakarmandi (2,700 m) and near Banikhet (1,500 m). Usually grows as lithophyte on humus rich shaded walls along the roadside.

A. adiantum-nigrum Linn., Sp. Pl. 1081, 1753.

Common in Jandrighat forest (1,500 m) and Lakarmandi (2,400 m) in rather dry places on the forest floor and on dry rocks.

***A. unilaterale** Lam., Ency. II. 305, 1786.

According to Hope, present in Dalhousie hills at 2,100 m. Not collected by authors.

BLECHNACEAE

Woodwardia radicans (L.) Smith in Mem. Ac. Turin. 5: 412, 1793.

This is a common species between 1,500-2,400 m growing along the Dalhousie-Banikhet road and in ravines.

POLYPODIACEAE

Lepisorus nudus (Hook.) Ching in Bull. Fan. Mem. Inst. Biol. 4 : 83, 1933.

Very common species of these hills, occurs both as epiphyte and lithophyte in somewhat exposed conditions between 900-2,100 m.

L. excavatus (Bory) Ching in Bull. Fan. Mem. Inst. Biol. 4: 68, 1933.

A very common epiphyte of the area, sometimes grows as lithophyte on shaded walls between 1,800-2,700 m especially at Motitiba (2,400 m) (Fig. 1).

L. clathratus (Clarke) Ching in Bull. Fan. Mem. Inst. Biol. 4: 71, 1933.

Very common between 1,800-3,000 m on Panjpulla road (1,800 m), Bakrota (2,400 m) and near Dainkund (3,000 m) growing as lithophyte but occasionally as epihyte also. This species has thinner texture and long stipe (Fig. 2).

Microsorium membranaceum (Don) Ching in Bull. Fan. Mem. Inst. Biol. 4: 309, 1933.

Common in shady places at low altitudes (1,500 m). Sometimes found as epiphyte also.

***M. zippelii** (Bl.) Ching in Bull. Fan. Mem. Inst. Biol. 4: 308, 1933.

According to Beddome met with in Dalhousie hills, at 1,500 m.

Phymatodes erythrocarpa (Mett. ex Kunze) Ching in Contrib. Inst. Bot. nat. Acad. Peiping 2 : 80, 1933.

This is a high altitude fern met with at Motitiba (2,400 m), growing on exposed rocks.

***P. oxyloba** (Wall.) Presl, Tent, Pterid. 196, 1836.

According to Hope, it is found in Dalhousie hills at 1,500 m. Not collected by authors.

Polypodium amoenum Wall., List n. 290, 1828.

Exceedingly common epiphyte and lithophyte between 1,800-2,400 m at Panjpulla (1,800 m), Balun (1,800 m), Motitiba (2,400 m), Bakrota (2,400 m).

P. sub-amoenum Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 550, Pl. 82, Fig. 2, 1880.

Common in Churah forest on Lakarmandi-Khajjiar road from 1,800-2,400 m growing as lithophyte along the roadside. New record for the area.

P. microrhizoma Clarke, ex Bak. in Hook. & Bak., syn. Fil., Ed. 2: 511, 1874.

Epiphyte or lithophyte, a very common species between 1,500-2,400 m. (Fig. 7).

P. lachnopus Wall., List n. 310, 1828 (nomen nudum).

A very common epiphyte on oaks from 1,500-1,800 m, near Banikhet. The distinguishing feature is the long, thin, creeping rhizome covered over by black long pointed scales.

FERN ALLIES

EQUISETACEAE

Equiseta debile Roxb. ex Vaucher in Mem. Soc. Phys. Hist. nat. Geneva 1(2) : 387, 1882.

Very common between 600-1,200 m, grows on calcareous gravelly soil along the streamlets at Bathri (900 m), Panjpulla (1,200 m), near Dunera (600 m).

E. diffusum D. Don, Prod. Fl. Nepal 19, 1825.

A common species at 1,500-2,100 m in Panjpulla khud (1,600 m), Karelnu waterfalls (2,100 m) growing on calcareous gravelly soil.

E. ramosissimum Desf. Fl. Atlant. 2 : 398, 1800.

Commonly grows along the streamlets between 1,500-2,100 m.

SELAGINELLACEAE

Selaginella chrysocaulos (Hook. & Grev.) Spr. in Bull. Acad. Roy. Sci., Belgique 10: 232, 1843.

A very common species growing on moist gravelly soil along roadside from 900-1,300 m.

S. chrysorrhizos Spr. in Mem. Acad. Roy. Sci., Belgique 24: 189, 1850.

Exceedingly common all around Dalhousie between 1,500-2,200 m, growing in moist shady places along Bakrota road (2,200 m). Balun (1,500 m) and main road of the town (2,000 m).

S. pallidissima Spring.

Common at 2,100-3,000 m in exposed places along the roadside from Lakarmandi to Dainkund.

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